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**Report of Screening Level Air Sampling for Volatile Organic Compounds
in and around the Cave Complex Associated with
La Jolla Springs, near Oak Grove Village, Missouri**

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Superfund

Background:

Staff from the Environmental Monitoring and Water Compliance Branch, Environmental Services Division of EPA Region VII collected five 24-hour integrated ambient air samples from various locations in and around Meramec Caverns. This field work was performed at the request of Region VII's Superfund Division to provide field monitoring support for the Missouri Department of Natural Resources (MDNR). The purpose of this sampling was to explore the possible linkages between documented TCE contamination in La Jolla spring which emerges inside Meramec Caverns and potential airborne concentrations of TCE. Air samples were collected in areas representing outdoor background levels, the publicly accessible commercialized portion of the cave complex, and wild portions of the cave complex. The two samples collected in the areas which are accessible to the public are named, "Site 1(River)" which represents outdoor background levels and "Site 2(Lobby)". The samples collected in the wild portion of the cave complex are named, "Site 3 (Slot 1)", "Site 4 (Slot 2)" and "Site 5 (Slot 3)".

Sampling and Analysis:

On October 8, 2002 a sampling team representing EPA Region VII, MDNR, and Missouri Department of Conservation entered both the commercialized and wild portions of Meramec Caverns to collect screening level data for characterization of potential airborne Volatile Organic Compound (VOC) contamination. Evacuated 6-liter stainless steel canisters were placed on the ground or floor on the morning of the 8th and then recovered 24-hours later after sampling. Samples were collected through a critical orifice type flow controller, calibrated to deliver 5.5 liters of sample over a 24-hour period. Initial canister vacuums were recorded between 30-25 "Hg and final canister vacuums were recorded between 8-3 "Hg, indicating successful sample collection.

Samples were delivered to a Air Toxice LTD. in Folsom, CA, under contract with MDNR and were analyzed on October 22, 2002 by modified EPA Method TO-15 using GC/MS in the full scan mode. In addition to submission of five environmental samples, one sample blank was submitted to the lab for quality assurance purposes.

The compounds analyzed by EPA Method TO-15 follow:

Freon 12	Toluene	1,3-Butadiene
Freon 114	trans-1,3-Dichloropropene	Acetone
Chloromethane	1,1,2-Trichloroethane	Carbon Disulfide
Vinyl Chloride	Tetrachloroethene	2-Propanol
Bromomethane	1,2-Dibromoethane (EDB)	trans-1,2-Dichloroethene
Chloroethane	Chlorobenzene	Vinyl Acetate
Freon 11	Ethyl Benzene	2-Butanone
1,1-Dichloroethene	m,p,-Xylene	Hexane
Freon 113	o-Xylene	Tetrahydrofuran
Methylene Chloride	Styrene	Cyclohexane
1,1-Dichloroethane	1,1,2,2-Tetrachloroethane	1,4-Dioxane
cis-1,2-Dichloroethene	1,3,5-Trimethylbenzene	Bromodichloromethane
Chloroform	1,2,4-Trimethylbenzene	4-Methyl-2-pentanone
1,1,1-Trichloroethane	1,3-Dichlorobenzene	2-Hexanone
Carbon Tetrachloride	1,4-Dichlorobenzene	Dibromochloromethane

Benzene	alpha-Chlorotoluene	Bromoform
1,2-Dichloroethane	1,2-Dichlorobenzene	4-Ethyltoluene
Trichloroethene	1,2,4-Trichlorobenzene	Ethanol
1,2-Dichloropropane	Hexachlorobutadiene	Methyl tert-Butyl Ether
cis-1,3-Dichloropropene	Propylene	Heptane

Analytical Results:

Sample results are reported in the following tabular format. Only the following compounds listed were detected in any sample.

Compound	Site 1 River	Site 2 Lobby	Site 3 Slot 1	Site 4 Slot 2	Site 5 Slot 3	Lab Blank
Freon 12 Dichlorodifluoromethane	6.7 ·g/m ³	4.4 ·g/m ³	5.1 ·g/m ³	5.2 ·g/m ³	32 ·g/m ³	ND
Freon 11 Trichlorofluoromethane	ND	6.0 ·g/m ³	19 ·g/m ³	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND
Methylene Chloride **	8.4 ·g/m ³ B	6.5 ·g/m ³ B	7.5 ·g/m ³ B	13 ·g/m ³ B	22 ·g/m ³ B	3.1 ·g/m ³
cis-1,2-Dichloroethene	ND	ND	6.6 ·g/m ³	ND	ND	ND
Trichloroethene	ND	100 ·g/m ³	450 ·g/m ³	ND	6.5 ·g/m ³	ND
Toluene	3.4 ·g/m ³	ND	ND	ND	18 ·g/m ³	ND
m,p-Xylene	ND	ND	ND	ND	5.8 ·g/m ³	ND
1,4-Dichlorobenzene	ND	28 ·g/m ³	ND	ND	ND	ND
Acetone	ND	11 ·g/m ³	ND	16 ·g/m ³	42 ·g/m ³	ND

**Methylene Chloride is found in all samples, including the laboratory blank sample. Sampling results for Methylene Chloride should be considered with great care.

ND = Not Detected

Discussion:

These results represent cave air concentrations for one 24-hour period at discrete sampling locations and are intended for screening purposes only. In order to make valid decisions about the potential for human or ecological health effects, additional study may be required. Topics for additional study may include, characterization of subterranean wind patterns, the effect of surface weather on subsurface winds, and subsurface pollutant transport and dilution within the cave complex. It is unlikely that the air flow patterns and pollutant dispersion in the cave complex are consistent over time. Given the complexity of the sampling environment, it may be very difficult to draw specific conclusions about the source of potential contaminants based solely upon air monitoring data. In addition, an appropriate exposure scenario must be derived for comparison of ambient air concentrations to human health effect benchmarks for employees and visitors of the cave complex. It is likely that health risks to cave visitors will be low due to an extremely short exposure duration (i.e. 1-2 days/year).

Recommendation:

Prior to considering additional monitoring, first develop health based exposure criteria for trichloroethene and other potential compounds of concern, representing chronic and acute inhalation exposure scenarios

for both employees and visitors to Meramec Caverns.

If additional monitoring is performed, design the sampling study in a manner that collects samples representative of both the chronic and acute exposure scenarios used to develop health based exposure criteria.